Employment of repairers will continue to decline, despite the introduction of sophisticated equipment, such as digital televisions. As long as the price of such equipment remains high, purchasers will be willing to hire repairers when malfunctions occur. However, the need for repairers to maintain this costly equipment will not be great enough to offset the overall decline in demand.

Earnings

Median hourly earnings of electronic home entertainment equipment repairers were $11.32 in 1998. The middle 50 percent earned between $8.90 and $14.59. The lowest 10 percent earned less than $6.82 and the highest 10 percent earned more than $18.59. Median hourly earnings in the industries employing the largest number of electronic home entertainment equipment repairers in 1997 are shown below:

Electrical repair shops	$11.40
Radio, television, and computer stores	11.00

Related Occupations

Other workers who repair and maintain electronic equipment include broadcast and sound technicians; computer, automated teller, and office machine repairers; electronics repairers, commercial and industrial equipment; and telecommunications equipment mechanics, installers, and repairers.

Sources of Additional Information

For information on careers and certification, contact:

☛ The International Society of Certified Electronics Technicians, 2708 West Berry St., Fort Worth, TX 76109. Internet: **http://www.iscet.org**

☛ Electronics Technicians Association, 602 North Jackson, Greencastle, IN 46135. Internet: **http://www.eta-sda.com**

Electronics Repairers, Commercial and Industrial Equipment

(O*NET 85717A and 85717B)

Significant Points

- Job opportunities will be best for applicants with a thorough knowledge of electronics, as well as repair experience.
- Growth will result from the increasing use of commercial and industrial electronic equipment as businesses strive to lower costs by implementing automation.

Nature of the Work

Businesses and other organizations depend on complex electronic equipment for a variety of functions. Industrial controls automatically monitor and direct production processes on the factory floor. Transmitters and antennae provide communications links for many organizations. The Federal Government uses radar and missile control systems to provide for the national defense. These complex pieces of electronic equipment are installed, maintained, and repaired by electronics repairers of commercial and industrial equipment.

Many repairers, known as *field technicians*, travel to factories or other locations to repair equipment. These workers often have assigned areas where they perform preventive maintenance on a regular basis. When equipment breaks down, field technicians go to a customer's site to repair the equipment. *Bench technicians* work in repair shops located in factories and service centers. They work on components that cannot be repaired on the factory floor.

Some industrial electronic equipment is self-monitoring and alerts repairers to malfunctions. When equipment breaks down, repairers first check for common causes of trouble, such as loose connections or obviously defective components. If routine checks do not locate the trouble, repairers may refer to schematics and manufacturers' specifications that show connections and provide instructions on how to locate problems. Repairers use software programs and testing equipment to diagnose malfunctions. Multimeters measure voltage, current, and resistance; signal generators provide test signals; and oscilloscopes graphically display signals. Repairers also use handtools such as pliers, screwdrivers, soldering irons, and wrenches, to replace faulty parts and to adjust equipment.

Repairers of electronic commercial and industrial equipment adjust and calibrate equipment.

Because component repair is complex, and factories cannot allow production equipment to stand idle, repairers on the factory floor usually replace defective units, such as circuit boards, instead of fixing them. Defective units are usually sent back to the manufacturer or to a specialized repair shop for repair. Bench technicians at these locations have the training, tools, and parts to thoroughly diagnose and repair components. These workers also locate and repair circuit defects, such as poorly soldered joints on circuit boards. Electronics repairers of commercial and industrial equipment often coordinate their efforts with other workers installing and maintaining equipment. (See the statements on industrial machinery repairers and millwrights elsewhere in the *Handbook.*)

Working Conditions

Many repairers work on factory floors where they are subject to noise, dirt, vibration, and heat. Bench technicians work primarily in repair shops where the surroundings are relatively quiet, comfortable, and well lighted. Field technicians spend much time on the road, traveling to different customer locations.

Because electronic equipment is critical to industries and other organizations, repairers work around the clock. Their schedules may include evening, weekend, and holiday shifts; shifts may be assigned on the basis of seniority.

Repairers may have to do heavy lifting and work in a variety of postures. They must follow safety guidelines and often wear protective goggles and hardhats. When working on ladders or on elevated equipment, repairers must wear harnesses to prevent falls. Before repairing a piece of machinery, these workers must follow procedures to insure that others cannot start the equipment during the repair process. They must also take precautions against electric shock by locking off power to the unit under repair.

Employment

Electronics repairers of commercial and industrial equipment held about 72,000 jobs in 1998. About 1 out of 5 salaried repairers was employed by the Federal Government—almost all by the Department of Defense at military installations around the country. Many repairers also worked

for wholesale trade companies, electrical repair shops, manufacturers of electronic components, and the telecommunications industry. About 1 in 10 repairers was self-employed.

Training, Other Qualifications, and Advancement
Knowledge of electronics is necessary for employment as an electronics repairer of commercial and industrial equipment. Many applicants gain this training through programs lasting 1 to 2 years at vocational schools and community colleges. Entry level repairers may work closely with more experienced technicians who provide technical guidance.

Repairers should have good eyesight and color perception in order to work with the intricate components used in electronic equipment. Field technicians work closely with customers and should have good communications skills and a neat appearance. Employers may also require that field technicians have a driver's license.

The International Society of Certified Electronics Technicians (ISCET) and the Electronics Technicians Association (ETA) administer certification programs for electronics technicians. Repairers may specialize—in industrial electronics, for example. To receive certification, repairers must pass qualifying exams corresponding to their level of training and experience. Both programs offer associate certifications to entry level repairers.

Experienced repairers with advanced training may become specialists or troubleshooters who help other repairers diagnose difficult problems. Others may move into higher paying jobs, such as skilled craft positions. Workers with leadership ability may become supervisors of other repairers. Some experienced workers open their own repair shops.

Job Outlook
Job opportunities should be best for applicants with a thorough knowledge of electronics, as well as electronics repair experience. Employment of electronics repairers of commercial and industrial equipment is expected to grow about as fast as the average for all occupations through 2008. Growth will be concentrated in private industry, where the increasing use of equipment will create new jobs for repairers. Employment of repairers in the Federal government will decline, however, as the Defense Department increases its use of outside contractors to provide repair services. In addition to employment growth, many job openings should result from the need to replace workers who transfer to other occupations or leave the labor force.

The use of commercial and industrial electronic equipment will become more widespread, as businesses strive to lower costs by increasing automation. Companies will install electronic controls, robots, sensors, and other equipment, to automate processes such as assembly and testing. As prices decline, applications will be found across a number of industries, including services, utilities, and construction, as well as manufacturing. Improved equipment reliability should not constrain employment growth; companies will increasingly rely on repairers, because any malfunction that idles commercial and industrial equipment is costly.

Earnings
Median hourly earnings of electronics repairers of commercial and industrial equipment were $17.11 in 1998. The middle 50 percent earned between $13.37 and $20.93. The lowest 10 percent earned less than $10.22 and the highest 10 percent earned more than $23.81. Median hourly earnings in the industries employing the largest numbers of electronics repairers of commercial and industrial equipment in 1997 are shown below:

Federal Government	$18.00
Professional and commercial equipment	15.60
Electrical repair shops	12.10

Related Occupations
Workers in other occupations who repair and maintain electronic equipment include broadcast and sound technicians; computer, automated teller, and office machine repairers; electronic home entertainment equipment repairers; and telecommunications equipment mechanics, installers, and repairers. Industrial machinery repairers and millwrights also install, maintain, and repair industrial machinery.

Sources of Additional Information
For information on careers and certification, contact:
☛ The International Society of Certified Electronics Technicians, 2708 West Berry St., Fort Worth, TX 76109. Internet: **http://www.iscet.org**
☛ Electronics Technicians Association, 602 North Jackson, Greencastle, IN 46135. Internet: **http://www.eta-sda.com**

Telecommunications Equipment Mechanics, Installers, and Repairers

(O*NET 85502, 85505, 85508, 85514, 85599A, 85599B, 85599C, and 85726)

Significant Points

- Growing demand for sophisticated telecommunications equipment will be offset by improved equipment reliability, resulting in average employment growth.
- Opportunities should be best for applicants with electronics training and computer skills.
- Weekend and holiday hours are common; repairers may be on call around the clock, in case of emergencies.

Nature of the Work
Telephones and radios depend on a variety of equipment to transmit communications signals. Electronic switches route telephone signals to their destinations. Switchboards direct telephone calls within a single location or organization. Radio transmitters and receivers relay signals from wireless phones and radios to their destinations. Newer telecommunications equipment is computerized and can communicate a variety of information, including data, graphics, and video. The workers who set up and maintain this sophisticated equipment are telecommunications equipment mechanics, installers, and repairers.

Central office installers set up switches, cables, and other equipment in telephone central offices. These locations are the hubs of a telephone network—they contain the switches that route telephone calls to their destinations. *PBX installers* set up private branch exchange (PBX) switchboards. This equipment relays incoming, outgoing, and interoffice calls for a single location or organization. To install switches and switchboards, installers first connect the equipment to power lines and communications cables and install frames and supports. They test the connections to insure that adequate power is available and that the communication links function. They also install equipment such as power systems, alarms, and telephone sets. New switches and switchboards are computerized; workers install software or may program the equipment to provide specific features. For example, as a cost-cutting feature, an installer may program a PBX switchboard to route calls over different lines at different times of the day. However, other workers, such as *network technicians* or *telecommunications specialists*, rather than installers generally handle complex programming. (The work of other computer specialists is described in the *Handbook* statement on computer systems analysts, engineers and scientists.) Finally, the installer performs tests to verify that the newly installed equipment functions properly.

The increasing reliability of telephone switches and switchboards has simplified maintenance. New telephone switches are self-monitoring and alert repairers to malfunctions. Some switches allow repairers to diagnose and correct problems from remote locations. When faced with a malfunction, the repairer may refer to manufacturers' manuals that provide maintenance instructions. PBX repairers determine if the problem is located within the PBX system, or if it originates in the